

# Sketch vs. Drag-and-Drop Input on a Pen-Based Tabletop Display

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## Goal

- Investigate the usability of the two most basic pen-input methods, drag-and-drop (DnD) and sketch, on a tabletop display in an emergency response setting.
- Provide a guideline to system designers building pen-based tabletop applications, especially with sketch recognition ability.

## Scenario

Simulated emergency response: operators in a command center populate a tabletop display map with critical incident icons.



Incident Symbols



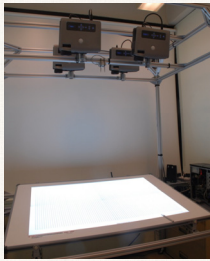
Tabletop Display Map

HSWG. Emergency symbol reference. <http://www.fgdc.gov/HSWG>

## Experiment

- 36 Participants (21 males, 15 females)
- 4x4x3 Partially-crossed mixed repeated-measures ANOVA
- Three Independent Variables:
  1. Input mode: 4 conditions
    - drag-and-drop: tree and palette symbol menu
    - sketch: low (75%) and high (90%) recognition accuracy
  2. Sketching complexity: 4 conditions
    - 20 symbols are categorized according to the drawing time
  3. Frequency of use: 3 conditions
    - Low (symbol used once), Med (3 times), High (5 times)
- Three Dependent Variables:
  1. Location accuracy
  2. Task completion time
  3. Preference

## Tabletop Display

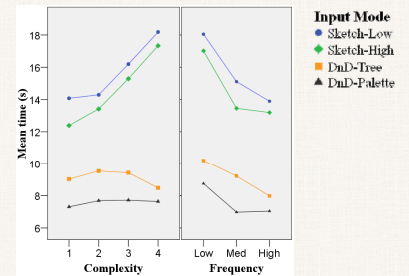
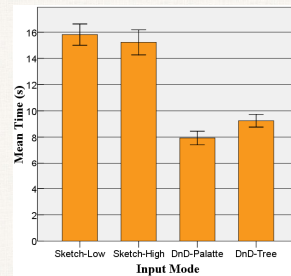


- Four mechanically aligned projectors, 2560 x 2048 resolution in total.
- 3.6' x 5' digitizing surface, stylus
- Digitizer coordinate system calibrated to image coordinate system

Ashdown, M. and Robinson, P. Escritoire: A personal projected display. *IEEE Multimedia*. 12(1)(2005). 34-42

## Result

- Location accuracy
  - Participants using DnD made significantly more location errors (6.07%) than those using sketch (3.57%) ( $p=.006$ )
  - In an emergency response setting, accuracy is crucial.
- Task completion time



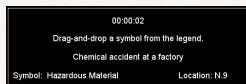
- DnD was significantly faster than sketch.
- Sketch can be competitive if symbols are simple to draw and easily remembered.

- Preferences
  - DnD was significantly preferred over sketch.
  - Participants felt that a pen-based copy/paste gesture would substantially reduce the sketch workload when the same symbol needed to appear repeatedly.

## Testbed Application

- Emergency response scenario, 1600x1400 pixel map.
- Provides two input modes: DnD and sketch.
- We measure task completion time and location accuracy.

[ UI components ]



Task panel

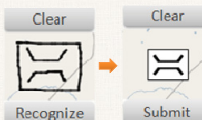


Palette menu



Tree menu

## Sketch Recognizer for Training



- Recognizes hand-drawn symbols and replaces them with image symbols.
- Used only for training session. Test sessions used a simulated recognizer, to allow precise control of accuracy rate.

Ouyang, T. Y. and Davis, R. A visual approach to sketched symbol recognition. In *Proc. of IJCAI 2009*, 1463-1468

## Future Work

- Test how the number of symbols affects operator performance (full set contains ~200 symbols)
- Test hybrid approaches: multimodal input, hierarchical marking menu, single-stroke shortcut sketch input, etc.

